Claims

[1] 1. A method for manufacturing the imide-substituted polymer comprising the steps of:

(i) copolymerization step done by dividing the feed into the Mixture (A) composed of aromatic vinyl monomers, initiators, and chain transfer agents and the Mixture (B) composed of unsaturated dicarboxylic anhydride monomers and solvents, and then charging copolymerization reactors simultaneously with them while adjusting the flow rate of each mixture according to the compositional ratio of the feed, and finally copolymerizing aromatic vinyl monomers and unsaturated dicarboxylic anhydride monomers in the copolymerization reactors;

(ii) separation step performed by supplying the polymerized solution discharged from the copolymerization reactors into a separator continuously, and then removing unreacted monomers and solvents sufficiently;

(iii) imide substitution step accomplished by supplying the polymer melt discharged from the separator continuously into imide substitution reactors and adding continuously the Mixture (C) composed of primary amines, catalysts for an imide substitution reaction, and solvents at the same time, and then reacting unsaturated dicarboxylic anhydride units in said copolymers with the primary amines; and

(iv) devolatilization step done by removing low-molecular-weight volatiles from the polymer solution discharged from the imide substitution reactors in the devolatilizer.

[2] 2. The method for manufacturing the imide-substituted polymer according to claim 1, wherein said aromatic vinyl monomer in the Mixture (A) is selected from the group consisting of styrene, a -methylstyrene, vinyl toluene, t-butylstyrene, chlorostyrene, substituted monomers thereof and mixtures thereof.

[3] 3. The method for manufacturing the imide-substituted polymer according to claim 1, wherein the amount of said aromatic vinyl monomer in the Mixture (A) is 20 to 60 wt% of the total amount of Mixtures (A) and (B) fed into said copolymerization reactors.

[4] 4. The method for manufacturing the imide-substituted polymer according to claim 1, wherein said initiator in the Mixture (A) is selected from the group of organic peroxides having two or more functional groups including 1,1-dibutyl-peroxy-3,3,5-trimethylcyclohexane, 1,1-dibutyl-peroxy-cyclohexane,

2,2-dibutyl-peroxy-butane, 2,2,4-trimethyl-pentyl-2-hydroperoxide, 2,5-dimethyl-2,5-di-(t-butyl-peroxy)hexane, 2,5-dimethyl-2,5-di-(benzoyl-peroxy)hexane, 1,1-di(t-amyl-peroxy)cyclohexane, 2,2-bis(4,4-di-t-butyl-peroxy-cyclohexyl)propane, ethyl-3,3-di(t-amyl-peroxy)butylate, ethyl-3,3-di(t-butyl-peroxy) butylate, 1,1-bis(t-butyl-peroxy)-3,3,5-trimethyl-cyclohexane, and t-butylperoxy-3,3,5-trimethylhexanoate.

[5] 5. The method for manufacturing the imide-substituted polymer according to claim 1, wherein the amount of said initiator in the Mixture (A) is 0.01 to 0.1 wt% of the total amount of Mixtures (A) and (B) fed into said copolymerization reactors.

[6] 6. The method for manufacturing the imide-substituted polymer according to claim 1, wherein said unsaturated dicarboxylic anhydride monomer in the Mixture (B) is selected from the group consisting of maleic anhydride, methylmaleic anhydride, ethylmaleic anhydride, phenylmaleic anhydride, citraconic anhydride, aconitic anhydride, and mixtures thereof.

[7] 7. The method for manufacturing the imide-substituted polymer according to claim 1, wherein the amount of said unsaturated dicarboxylic anhydride monomer in the Mixture (B) is 10 to 30 wt% of the total amount of Mixtures (A) and (B) fed into said copolymerization reactors.

[8] 8. The method for manufacturing the imide-substituted polymer according to claim 1, wherein said solvent in the Mixture (B) is selected from the group consisting of methyl ethyl ketone (MEK), cyclohexanone, methylisobutyl ketone (MIBK), acetone, dimethyl formamide, dimethyl sulfoxide, and mixtures thereof.

[9] 9. The method for manufacturing the imide-substituted polymer according to claim 1, wherein the amount of said solvent in the Mixture (B) is 20 to 60 wt% of the total amount of Mixtures (A) and (B) fed into said copolymerization reactors.

[10] 10. The method for manufacturing the imide-substituted polymer according to claim 1, wherein a temperature of polymerization in said copolymerization step is ranged from 80 to 150 °C.

[11] 11. The method for manufacturing the imide-substituted polymer according to claim 1, wherein said copolymerization reactors in said copolymerization step have one or more reactors consecutively and the temperature of each reactor is increased gradually within the range of 80 to 150 °C.

[12] 12. The method for manufacturing the imide-substituted polymer according to claim 1, wherein the inside of said separator in said separation step has a temperature condition within the range of 150 to 300 °C and a pressure condition within the range of 20 to 200 torr.

[13] 13. The method for manufacturing the imide-substituted polymer according to claim 1, wherein said primary amine in the Mixture (C) is selected from the group consisting of methylamine, ethylamine, propylamine, butylamine, hexylamine, cyclohexylamine, decylamine, aniline, toluidine, chlorophenylamine, bromophenylamine, and mixtures thereof.

[14] 14. The method for manufacturing the imide-substituted polymer according to claim 1, wherein the content of said primary amine in the Mixture (C) is ranged from 05 to 2.0 times in the mole ratio to the content of the unsaturated di-carboxylic anhydride units in the polymer melt supplied from the separation step.

[15] 15. The method for manufacturing the imide-substituted polymer according to claim 1, wherein said catalyst for an imide substitution reaction in the Mixture (C) is selected from the group consisting of trimethylamine, triethylamine, tributylamine, and mixtures thereof.

[16] 16. The method for manufacturing the imide-substituted polymer according to claim 1, wherein the amount of said catalyst in the Mixture (C) is less than 10 wt% of the amount of the primary amine in the Mixture (C).

[17] 17. The method for manufacturing the imide-substituted polymer according to claim 1, wherein the amount of said solvent in the Mixture (C) is 05 to 3.0 times of the amount of said solvent in the Mixture (B).

[18] 18 The method for manufacturing the imide-substituted polymer according to claim 1, wherein the reaction temperature of said imide substitution step is ranged from 120 to 200 °C.

[19] 19. The method for manufacturing the imide-substituted polymer according to claim 1, wherein the inside of said devolatilizer in said devolatilization step has a temperature condition within the range of 200 to 350 °C and a pressure condition within the range of 10 to 100 torr.

[20] 20 The method for manufacturing the imide-substituted polymer according to claim 1, wherein the conversion of said unsaturated dicarboxylic anhydride in said copolymerization step is greater than 95 wt%.

[21] 21. The method for manufacturing the imide-substituted polymer according to claim 1, wherein the residence time in said copolymerization step is within the

range of 2.0 to 5.0 hours and the residence time in said imide substitution step is within the range of 1.5 to 4.0 hours.

[22] 22. The method for manufacturing the imide-substituted polymer according to claim 1, wherein the content of aromatic vinyl homopolymers contained in said imide-substituted polymer manufactured through said devolatilization step is less than 3 wt%.

[23] 23. An imide-substituted polymer manufactured according to any of Claims 1 through 22.